

**INTERSTATE 29 NORTHBOUND  
BRIDGE over the  
PERRY CREEK CONDUIT**

**SIOUX CITY, IOWA**



**FIRE DAMAGE INSPECTION  
REPORT**

**NOVEMBER 2, 2019**

*Prepared for:*  
**Iowa Department of Transportation**



*Prepared by:*  
**HDR**



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| STRUCTURAL DESIGN   |  |
|---|--|
|  | <p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> <br/> <small>Signature</small><br/> <b>Aleksander T. Nelson</b><br/> <small>Printed or Typed Name</small> </div> <div style="text-align: right;"> 11/08/2019<br/> <small>Date</small> </div> </div> <p>My license renewal date is December 31, <u>2020</u></p> |
| Pages or sheets covered by this seal: <u>All</u>                                    |  |

## **GENERAL DESCRIPTION OF EFFORT**

On November 2, 2019, HDR performed a Fire Damage Inspection of the Interstate 29 Northbound Bridge carrying traffic over the Perry Creek Conduit in Sioux City, Iowa for the Iowa Department of Transportation (IDOT) as a result of a fire under the bridge on October 30, 2019.

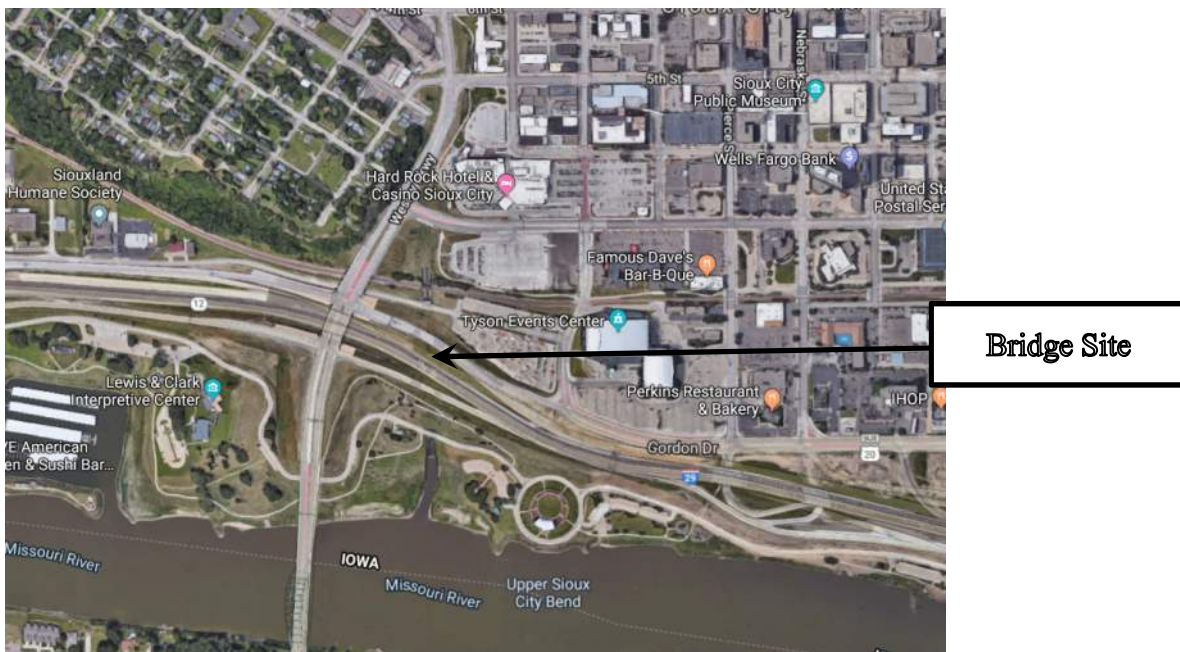
The inspection consisted of visual inspection of the fire damage to the bridge members, sounding of suspect concrete surfaces and visual investigation for beam sag or other misalignment. Exposed reinforcing and prestressing strands were visually inspected for noticeable damage. No destructive testing, sampling or petrographic coring/ lab testing was completed.

The inspection was performed by an HDR field crew consisting of:

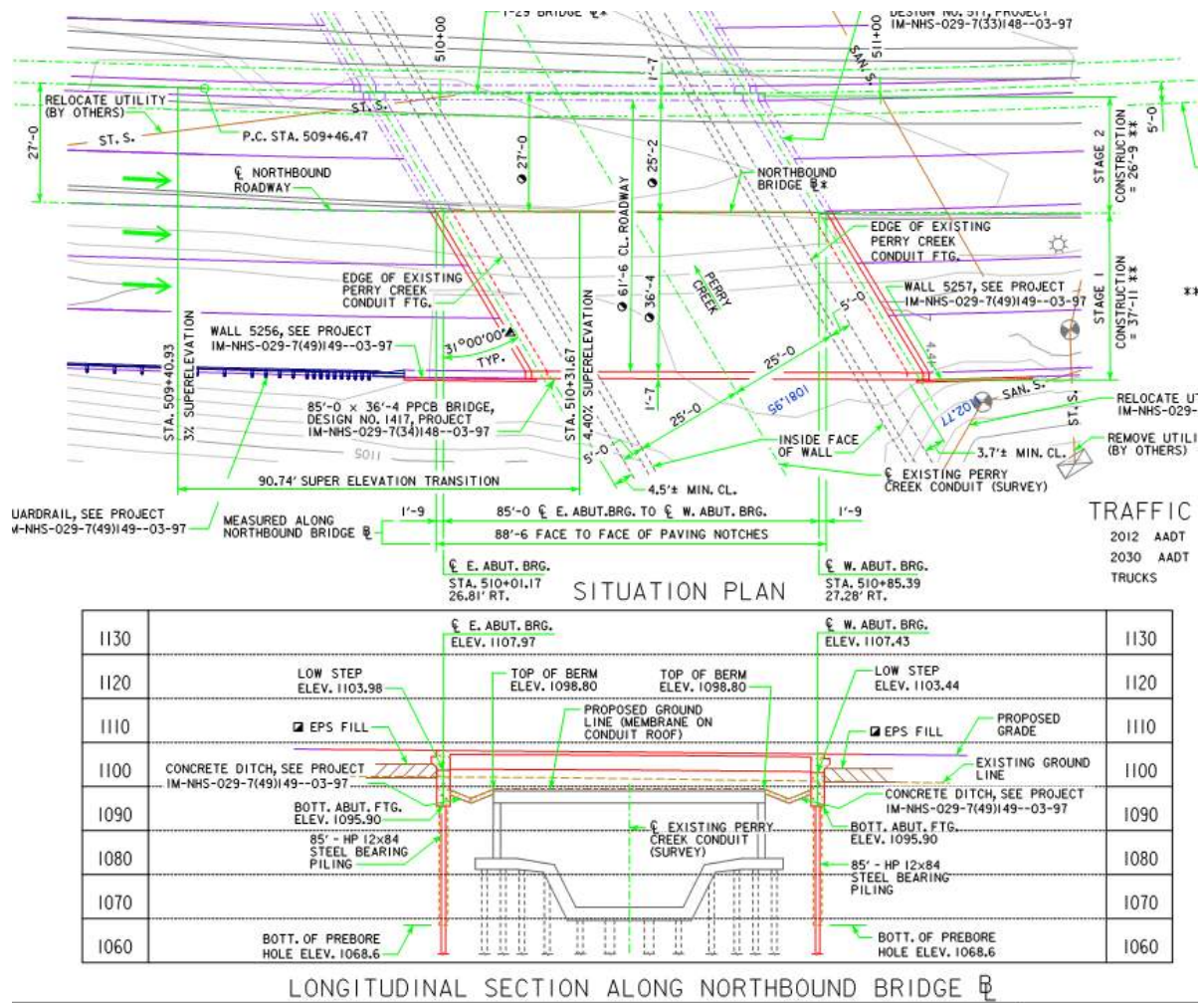
- |                         |                     |
|-------------------------|---------------------|
| • Aleksander Nelson, PE | Team Leader         |
| • Adam M. Miller, EI    | Assistant Inspector |
| • Paul Knievel, PE      | Assistant Inspector |

Access to the bridge superstructure was available from the ground level and no additional equipment was used to access the bridge. A portable generator and electric work lights were used to illuminate the work area.

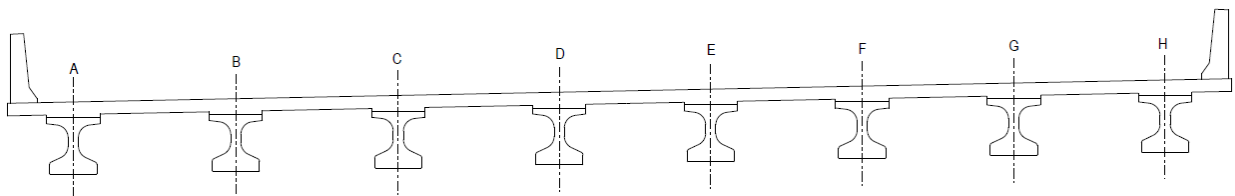
A conference call was held with the Iowa DOT Bridges and Structures Bureau and District 3 on November 4<sup>th</sup>, 2019 to share the findings of the damage inspection.



*Location Map*



Plan and Elevation (from Contract Plans)



Section - Looking Upstaion





*North side of Bridge - Looking toward West Abutment*



*North side of Bridge - Looking toward East Abutment*

## **STRUCTURE DESCRIPTION**

The Interstate 29 NB Bridge is a single span pretensioned prestressed concrete beam (PPCB) bridge with integral abutments over the Perry Creek Conduit measuring 85 feet between abutment centerlines. The bridge carries three lanes of traffic northbound on Interstate 29. There is a separate adjacent structure carrying southbound traffic. The bridge consists of eight lines of Iowa DOT BTB beams. The deck has a clear roadway width of 61'-6". The deck is an 8" single course concrete deck.

## **INSPECTION FINDINGS**

- **Beams "A" and "B"**
  - Beams "A" and "B" were observed to be covered with a thick layer of soot with little visible damage.
  - A single isolated spall was observed on the top edge of the bottom flange of the north face of Beam "B", approximately  $\frac{1}{4}$  of the span length from the east abutment.
  - Sounding of the beams did not indicate delaminated concrete.
  - Remaining camber was visually approximated to be between  $\frac{1}{2}$ " to 1".
- **Beam "C"**
  - Beam "C" was observed to be soot covered with surface spalling along the top edge of the bottom flange on the north face.
  - A single isolated spall to the depth of the prestressing strand was observed approximately  $\frac{1}{4}$  of the span length from the east abutment.
  - Sounding of the beams did not indicate delaminated concrete.
  - Remaining camber was visually approximated to be between  $\frac{1}{2}$ " to 1".
- **Beams "D", "E", and "F"**
  - Beams "D", "E", and "F" were observed to have extensive bottom flange spalling and delaminated concrete for the length of the beam.
  - Both exterior strands in the bottom layer of strands were exposed and soot stained the majority of the length of all three beams.
  - Web spalling was observed on the north face of Beam "D" and the south face of Beam "E".
  - Sounding indicated delaminated concrete on the top flange of the north face of Beam "D" as well as the top flange on both faces of Beam "E".
  - No visually noticeable remaining camber was present.

- **Beam “G”**

- Beam “G” was observed to have bottom flange spalling and delaminated concrete.
- The bottom exterior strand was exposed and soot stained at the south face of the beam.
- The top edge of the bottom flange had surface spalling on the north face of the beam.
- Remaining camber was visually approximated to be between ½” to 1”.

- **Beam “H”**

- Beam “H” was observed to have minor bottom flange spalling along the south half of the girder.
- Sounding indicated delaminated concrete along the top edge of the bottom flange for the same length.
- Remaining camber was visually approximated to be between ½” to 1”.

- **Deck Soffit**

- The deck soffit between Beams “A” and “C” was soot covered but had no noticeable damage.
- Minor surface spalling of the deck soffit was observed between Beams “C” and “D” with hammer sounding finding noticeable delaminations.
- More extensive surface spalling was observed from Beam “D” to Beam “G” as well as the east half of the soffit between Beams “G” and “E”.
- Hammer sounding found no noticeable concrete delamination.
- Polycarbonate stay-in-place forms used between Beam “D” and “H” had been consumed.

## **RECOMMENDATIONS**

1. Maintain traffic only between Beams “A” and “C” unless load testing is completed to verify the capacity of Beam “D”.
2. Replace damaged beams.

## **FINDINGS CONFERENCE CALL**

Following the damage inspection, a conference call was held on November 4<sup>th</sup>, 2019 with the Iowa DOT Bridges and Structures Bureau and District 3 to share the initial findings from the damage inspection and to discuss traffic on the I-29 NB Bridge. HDR's presentation materials can be found in Appendix B.

Attending the meeting were the following:

- |                   |                 |
|-------------------|-----------------|
| • Al Nelson       | HDR             |
| • Phil Rossbach   | HDR             |
| • Todd Horton     | HDR             |
| • Paul Knieval    | HDR             |
| • Scott Neubauer  | IDOT BSB        |
| • Jim Hauber      | IDOT BSB        |
| • Shane Tymkowicz | IDOT District 3 |
| • Dean Herbst     | IDOT District 3 |
| • Darwin Bishop   | IDOT District 3 |
| • Jason Klemme    | IDOT District 3 |
| • Dakin Schultz   | IDOT District 3 |
| • Tony Lazarowicz | IDOT District 3 |

## **Meeting Minutes**

- Most extensive damage is from Beam "D" to Beam "F". These beams appear to have lost camber by comparison to the other beams.
- Loss of camber is significant. Exposed strands covered with soot are concerning. Many of the strands were likely exposed directly to the fire.
- Despite being exposed, there is no visible damage of the exposed strands.
- Hollow spaces in top flanges could possibly be attributed to the burning of the stay-in-place forms.
- There is currently one lane of traffic on the bridge and District would like to open a second lane. A 26' roadway would require a temporary barrier on top of Beam "D".
- Beam "D" should be load tested to see if a second temporary NB lane can be added.
- Beams "D" through "F" took the worst of the damage and would probably behave similarly. At a minimum, load testing should be done on top of Beam "D". If other damaged beam lines are considered for supporting live load, additional beam live load testing could potentially be considered.
- Load testing should be able to be completed within a few days.
- The southbound bridge is scheduled to be complete in about 6 weeks. Preference is to open a second northbound lane on the existing Northbound bridge for the winter and wait until next year to do repairs.
- Longer term monitoring should be considered.



- On previous bridge fires HDR has used petrographic testing to determine the limits of concrete removal. This is a very time consuming process and would not likely be possible on the flanges of the beams.
- If the load testing provides adequate results, a second lane on the northbound bridge could possibly be added as a temporary condition with permanent repairs next year.
- Getting a second northbound lane open as quickly as possible is critical. If traffic needs to be moved to the southbound side for repairs, staging needs to be determined so median barriers are not constructed and then torn out again next spring.
- If anything more than Beams “D”, “E”, and “F” need replacing, consideration should be given to replacing the entire bridge.
- Is damage mostly from the heat or the blast? The damage is extensive and widely distributed along the flanges, which was probably due to heat more than blast. No obvious signs of blast impact damage were found.
- Sioux City Fire Department performed air testing beneath the bridge and did not deem it a hazardous environment.



*Photo 001: Bottom Flange – Beam "H"*



*Photo 002: Aluminum supports Between Beam "G" and "H", melted polycarbonate forms.*



*Photo 003: Beam "G" – Bottom Flange Spalling*



*Photo 004: Deck Soffit Between Beam "G" and Beam "H"*





*Photo 005: Beam “G” – Flange Spalling*



*Photo 006: Beam “G” – Bottom Flange Spalling*



*Photo 007: Beam "G" – Bottom Flange Spalling*



*Photo 008: Beam "G" – Bottom Flange Spalling*





*Photo 009: Beam "G" – Bottom Flange Spalling*



*Photo 010: Beam "G" – Bottom Flange Spalling*





*Photo 011: Beam “G” – Flange Spalling, South Face*



*Photo 012: Beam “G” – Flange Spalling, South Face*



*Photo 013: Beam “G” – Flange Spalling, South Face*



*Photo 014: Beam “G” – Bottom Flange Spalling, South Face*



*Photo 015: Melted Formwork between Beam "G" and Beam "F"*



*Photo 016: Melted Formwork between Beams "G" and "F"*





*Photo 017: Melted Formwork Between Beams "G" and "F"*



*Photo 018: Beam "F" – Bottom Flange Spalling and Exposed Strand, North Face*



*Photo 019: Beam “F” – Bottom Flange Spall and Exposed Strand, North Face*



*Photo 020: Beam “F” – Bottom Flange Spall, North Face*





*Photo 021: Beam “F” – Bottom Flange Spalling, North Face*



*Photo 022: Beam “F” – Bottom Flange Spall and Exposed Strand, North Face*





*Photo 023: Beam "F" – Exposed Strand and Stirrups, North Face*



*Photo 024: Beam "F" – Exposed Strand and Stirrups, North Face*



*Photo 025: Beam "F" – Exposed Strand and Stirrups, North Face*



*Photo 026: Beam "F" – Bottom Flange Spalling*





*Photo 027: Beam "F" – Bottom Flange Spalling*



*Photo 028: Beam "F" – Bottom Flange Spalling*



*Photo 029: Beam “F” – Bottom Flange Spalling, South Face*



*Photo 030: Beam “F” – Bottom Flange Spalling, South Face*





*Photo 031: Beam "F" – Bottom Flange Spalling, South Face*



*Photo 032: Beam "F" – Exposed Strand and Stirrups, South Face*



*Photo 033: Beam “F” – Bottom Flange Spalling, South Face*



*Photo 034: Deformed Formwork supports between Beams “F” and “E”*





*Photo 035: Deformed Formwork supports between Beams "F" and "E"*



*Photo 036: Deformed Formwork supports between Beams "F" and "E"*



*Photo 037: Beam "E" – Bottom Flange Spalling, North Side*



*Photo 038: Beam "E" – Bottom Flange Spalling, North Side*



*Photo 039: Beam “E” – Bottom Flange Spalling, North Face*



*Photo 040: Beam “E” – Top Flange Spalling, North Face*





*Photo 041: Beam “E” – Bottom Flange Spalling, North Side*



*Photo 042: Beam “E” – Exposed Strand and Stirrup, North Face*



*Photo 043: Beam "E" – Exposed Strand and Stirrups, North Face*



*Photo 044: Beam "E" – Exposed Strand and Stirrups, North Face*





*Photo 045: Beam "E" – Exposed Strand and Stirrups, North Face*



*Photo 046: Beam "E" – Top Flange Spalling, North Face*





*Photo 047: Beam "E" – Bottom Flange Spalling, South Face*



*Photo 048: Beam "E" – Exposed Strand and Stirrup, South Face*



*Photo 049: Beam “E” – Web Spalling, South Face*



*Photo 050: Beam “E” – Exposed Strands and Web Spalling, South Face*





*Photo 051: Beam "E" – Exposed Strand and Stirrup, South Face*



*Photo 052: Beam "D" – Web Spalling, North Face*





*Photo 053: Beam "D" – Bot. Flange Spalling, North Face*



*Photo 054: Beam "D" – Web and Top Flange Spalling, North Face*



*Photo 055: Beam “D” – Exposed Strand and Stirrups, North Face*



*Photo 056: Beam “D” – Exposed Strand and Stirrups, North Face*



*Photo 057: Beam “D” – Exposed Strand and Stirrup, South Face*



*Photo 058: Deck Spalling between Beams “D” and “C”*





*Photo 059: Beam "D" – Bottom Flange Spalling, South Face*



*Photo 060: Beam "C" – Bottom Flange Spalling, North Face*



*Photo 061: Beam "C" – Bottom Flange Spalling, North Face*



*Photo 062: Beam "C" – Bottom Flange Spalling, North Face*



*Photo 063: Beam “C” – Bottom Flange Spalling, North Face*



*Photo 064: Beam “C” – Bottom Flange Spalling, North Face*





*Photo 065: Beam "C" – Bottom Flange*



*Photo 066: Beam "B" – Isolated Spall, North Face*



*Photo 067: Bay Between Beam "B" and Beam "A", Facing West*



*Photo 068: Bay Between Beam "B" and Beam "A", Facing East*



*Photo 069: Left Overhang, Facing East.*



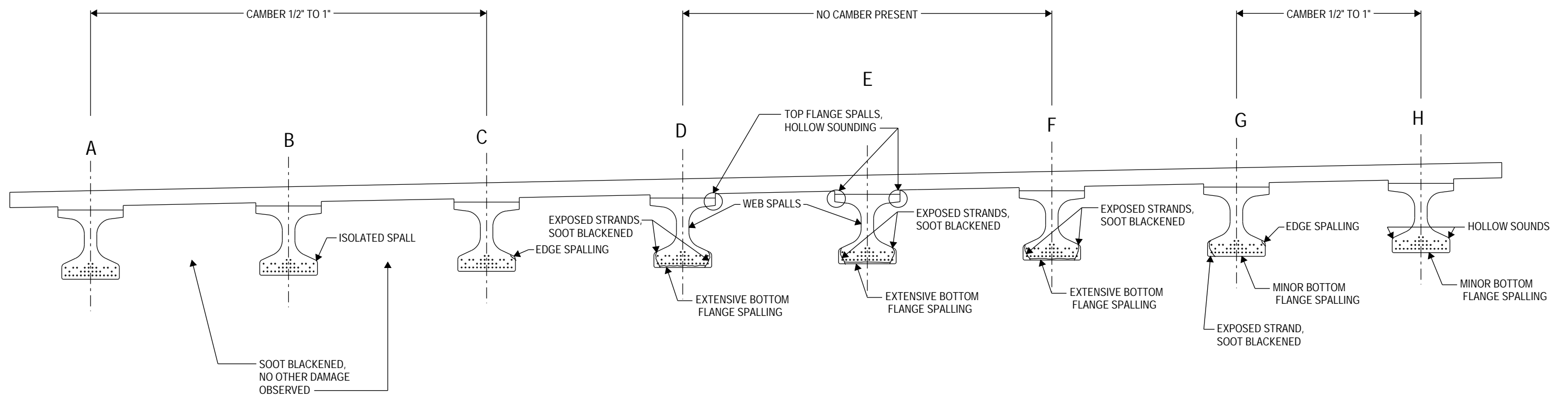
*Photo 070: Left Overhang, Facing West.*



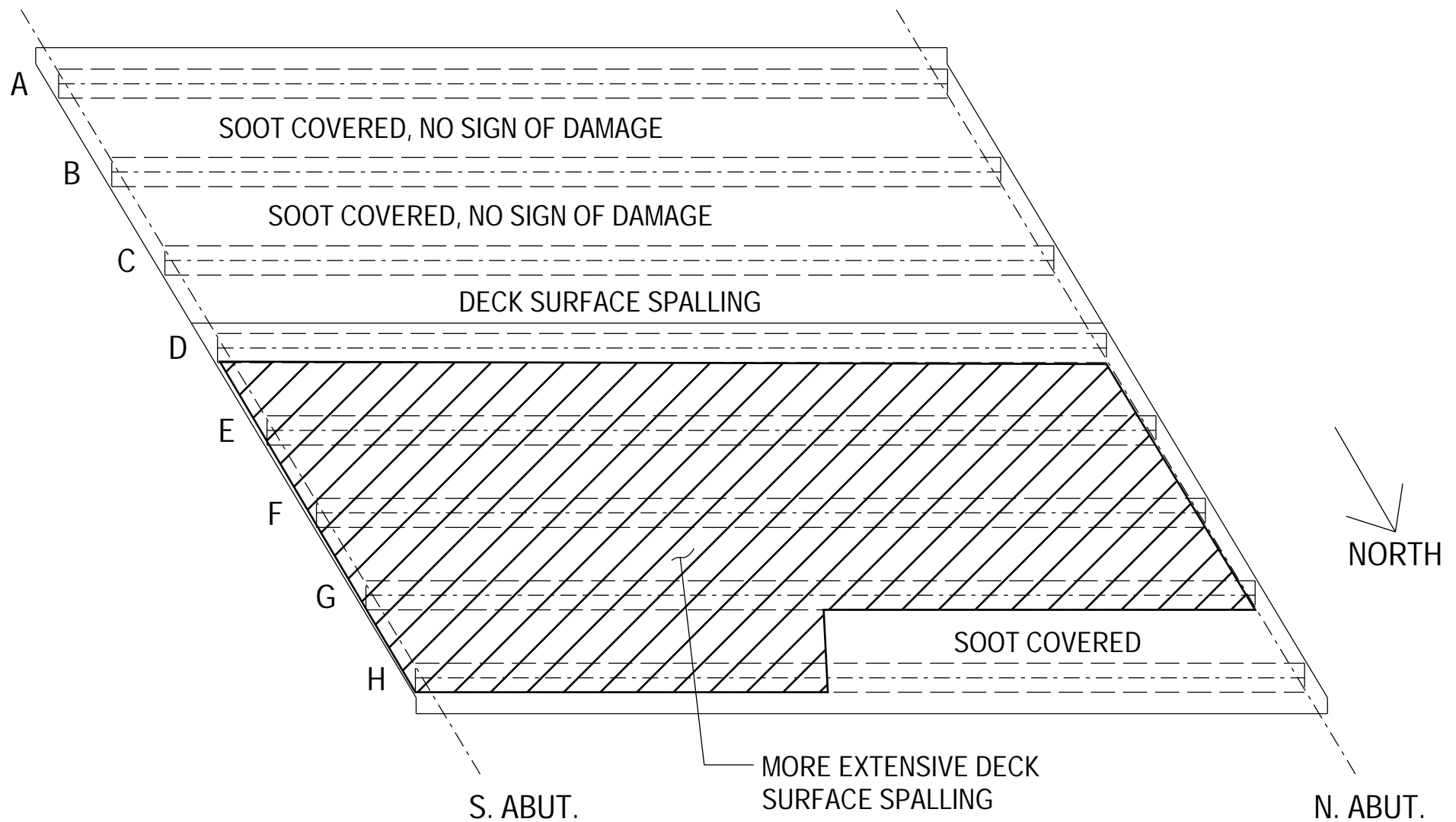
# Appendix A

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## *Conference Call Presentation*



NORTHBOUND BRIDGE SECTION  
LOOKING UPSTATION



NORTHBOUND BRIDGE DECK CONDITION

NORTHBOUND





GIRDER "A"/"B" & "B"/"C" - TYPICAL  
CONDITION



GIRDER "C" – MINOR BOTTOM FLANGE  
SPALL, NORTH FACE



GIRDER "D" – WEB SPALLS, NORTH  
FACE



GIRDER "D" – WEB SPALLING, NORTH  
FACE



GIRDER "D" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
NORTH FACE



GIRDER "D" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
SOUTH FACE





GIRDER "E" – TOP FLANGE SPALLS,  
NORTH FACE



GIRDER "E" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
NORTH FACE



GIRDER "E" – BOTTOM FLANGE  
SPALLING, EXPOSED STRAND, AND WEB  
SPALLING, SOUTH FACE



GIRDER "F" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
NORTH FACE





GIRDER "F" – BOTTOM OF BOTTOM  
FLANGE, EXTENSIVE SPALLING



GIRDER "F" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
SOUTH FACE





GIRDER "G" – BOTTOM OF BOTTOM  
FLANGE, MINOR SPALLING



GIRDER "G" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
SOUTH FACE



GIRDER "G" –BOTTOM FLANGE MINOR  
SPALLING, NORTH FACE



GIRDER "G" – BOTTOM FLANGE  
SPALLING AND EXPOSED STRAND,  
SOUTH FACE



GIRDER "H" –BOTTOM FLANGE MINOR  
SPALLING





TYPICAL BOTTOM OF DECK SPALLING



TYPICAL BOTTOM OF DECK SPALLING